INDIAN TEA ASSOCIATION

SCIENTIFIC DEPARTMENT

TOCKLAI EXPERIMENTAL STATION

ANNUAL REPORT—1936

CHEMICAL BRANCH

Calcutta:
PRINTED AT THE CATHOLIC ORPHAN PRESS,
3 & 4, Portuguese Church Street.

1937

CHEMICAL.

A. Factors affecting tea-value.

Three factors affecting tea-value were investigated during the year in trials which extended over the whole of the manufacturing season. The samples of tea made were submitted to six London tasters and five (in some cases six) tasters in India. The factors studied were :

1. *Manuring.*—The influence of phosphoric acid manure with and without potash manure, in each case with a constant quantity of soluble nitrogenous manure supplying 40 lbs. nitrogen per acre.

2. *Jat of Bush.*—Four jats, including two light leaf Assam, one dark leaf Burma, and China, were investigated.

3. *Pruning.*—A comparison of pruned and unpruned leaf of each of the four above mentioned jats, was made.

1. *Manuring with soluble phosphate and potash manures.*

As a result of weekly manufactures over rains and autumnal periods it was shown that potash manures resulted in a very slight but significant depreciation in value of tea; this being observed by Calcutta and London valuers. The drop in valuation due to potash was about 1/24th anna (Calcutta) and 1/10th of a penny (London). Phosphates gave in the opinion of Calcutta tasters a slight increase in value of tea, amounting to about 1/24th anna over the season. London valuers found no difference due to phosphoric acid manuring. Leaf from the experimental plots was insufficient for manufacture during the early part of the second flush but such manufactures as were made during the second flush period indicated no greater superiority of teas

manured with phosphoric acid, over those not manured with this mineral, than was obtained during rains or autumnal periods.

2. *Jat of bush.*

Leaf from four jats of bush was manufactured weekly throughout the season. Of these, two were light leaf Assam jats, one (Light Leaf A) originated from a well-known Upper Assam seed garden, the other (Light Leaf B) was from a middle Assam seed garden now abandoned. The third jat was a dark leaf Manipuri from a Cachar seed garden, while the fourth was China, the parent bushes of which are reputed to have come direct from China.

The results from this series of manufactures confirm and emphasise an important fact regarding the connection between jat and quality. It is often assumed that light leaf jats produce better tea than dark leaf jats do. While this is true of some light leaf jats, there are others which, while they may produce teas with quality, do not give teas of sufficient strength, colour, or other characteristics to warrant a higher valuation than that obtained for teas made from certain dark leaf jats. Of the two light leaf jats manufactured, one gave consistently better teas than the other, and better than the dark leaf variety, or the China. The other light leaf jat, although its teas had quality, produced thin liquors, lacking in strength and colour, on which account the teas were seldom preferred to the dark leaf teas, and often placed inferior.

There is probably as great a variation among teas made from various dark leaf jats as there is among those from light leaf jats; and though certain characteristics of the made teas may be associated in a broad way with light and dark leaf jats, the variation that exists among apparently similar commercial jats of tea is undoubtedly much greater than is generally realised.

The following tables give average valuations for the four jats and for pruned as compared with unpruned tea.

Averages of 5 Calcutta tasters.

	1st period June-July	2nd period August-September	3rd period October-November	Average for all 3 periods
	As. P.	As. P.	As. P.	As. P.
Light leaf A. ...	11- 7·9	10- 1·7	10- 1·3	10-7·6
„ „ B. ...	10-11·4	9-10·8	10- 0·5	10-3·5
Dark leaf ...	11- 2·9	10- 0·5	9-11·8	10-5·1
China	11- 0·3	9- 7·5	9- 7·8	10-1·2
Significant difference ...	4.4	1.1	1·6	2·1
Pruned tea ...	11- 4·9	9-11·7	9-11·6	10-5·4
Unpruned tea ...	11- 0·4	9-10·6	9-11·0	10-3·3
Significant difference ...	3·1	0·8	...	1·5

Averages of 6 London tasters.

	1st period June-July	2nd period August-September	3rd period October-November	Average for all 3 periods
	s. d.	s. d.	s. d.	s. d.
Light leaf A. ...	1-3·1	1-1·6	1-3·3	1-2·67
„ „ B. ...	1-2·5	1-1·1	1-2·9	1-2·17
Dark leaf ...	1-2·4	1-1·4	1-2·7	1-2·17
China	1-2·1	1-0·7	1-0·9	1-1·23
Significant difference ...	0·4d.	0·2d.	·01d.	0·15d.
Pruned tea ...	1-2 9	1-1·3	1-25	1-2·23
Unpruned tea ...	1-2·2	1-1·1	1-24	1-1·90
Significant difference ...	0·3d.	0·16d.	·07d.	0·10d.

These tables illustrate the marked preference given to one light leaf jat, compared with the other light leaf jat which has in fact given teas certainly no better, occasionally of less value, than those of the dark leaf jat. The China jat, grown in the plains, has given on average the poorest teas in each of the three seasons. One or two good valuations only were given on account of marked flavour during the early second flush. No marked autumnal flavour was produced by any of the four jats.

3. *Pruning.*

The valuations given above show that pruned tea has proved consistently preferable to unpruned tea throughout the season, though the greatest difference is during the second flush period (June—July); the difference is smallest during the autumnal period.

B. Analysis of tea.

Analysis of tannin, caffeine and soluble solid contents of liquors of teas manufactured during second flush, rains and autumnal periods have brought to light some interesting facts. Pruned bushes have given tea which throughout the season is higher in the above constituents, particularly caffeine, than unpruned tea.

Teas made from different jats vary considerably in their constituents. Some light leaf varieties are high while others are low in tannin, soluble solids, etc., and this variation does not correlate with tea value when teas of different jats are compared, with the exception that China varieties, always valued low, are also very low in soluble constituents.

Potash and phosphate manures have no appreciable influence on the tannin, caffeine or soluble solids in tea.

As observed previously however, potash and phosphoric acid manuring increase respectively the percentage of potash and phosphoric acid in the teas made. Heavy phosphoric acid manuring has a depressing effect on the potash content of tea.

It is thought that some correlation may be obtained when sufficient data has been accumulated, between these two mineral constituents of teas, and certain of their liquor characteristics.

C. Soil acidity.

As in previous years much of the work in this section has consisted in routine determination of the soil acidity of samples from areas of poor tea, areas intended for replanting, and proposed nursery sites.

In addition, changes in soil acidity due to different forms of manuring have been studied on various plots at Borbhetta.

This routine work has provided a considerable amount of data from which fresh conclusions have been drawn and recommendations of a practical nature can be made, supplementing our previous knowledge and advice given on treatment of soils which are under-acid for tea.

Until comparatively recently a pH of 5.5 was regarded as about the optimum value for most tea soils. It is now however possible to differentiate between various types of tea soils, thus a sandy soil may grow tea well with a pH up to 5.6 but for a stiff soil, *e.g.*, a red bank, or clay flat type, a pH of about 5.2 is considered desirable, while it is likely that the optimum acidity is greater even than this value (*i.e.*, the pH value lower). Bheel soils growing healthy tea commonly have a pH of 4.5 or less, and any bheel with a pH of over 5.0 is almost certainly in need of treatment for increasing its acidity.

A complicating factor in the determination of optimum acidity, is the fact that tea, once established on a normally acid soil, may suffer little if the surface soil is made less acid by liming. Examples of old tea, growing well on areas of which the surface soil is under acid, are common. In these cases how-

ever the bush has the major portion of its root system in a normally acid soil. An attempt to replant such areas without correcting the acidity of the surface soil would not be expected to prove successful as the young plants would start under the handicap of having most of their roots in the upper layer of under-acid soil. The treatment for such soils consists in application of sulphur in sufficient quantity, determined by laboratory tests, to bring the soil to an acidity sufficiently high for its type, to ensure good growth of tea.

No evidence has yet been obtained, of harm resulting from too high a soil acidity.

A soil treated with sufficient sulphur to make it more acid than any soil yet tested, is growing as good tea as adjoining soil of normal acidity. There is however the possibility of deficiency of bases, *e.g.*, lime, potash, etc., resulting from a prolonged over-acid condition during which period these bases may be almost completely leached out. For this reason, on soils naturally very acid, the long-continued use of an acid manure like sulphate of ammonia may not be desirable. The occasional use of calcium cyanamide may be required in such cases.

D. Analysis of soil and composts.

(1). *Effect of inorganic manures on soil organic matter and nitrogen.*

The dark Mesai-Manipuri plots referred to on page 29 of the Agricultural Report are devoted to trials of the effect of different quantities of complete inorganic fertilisers in single and divided doses, on the yield and quality of tea. Analysis was made of the nitrogen content and the "Loss on Ignition" of the soils from 49 of these plots. These 49 plots are in groups of 7 plots, each group having a different manurial treatment. The table below

gives the average values of organic matter (Loss on Ignition) and nitrogen for each manurial treatment :—

Manures to supply lbs. per acre			How applied	per cent on dry soil		Ratio of organic matter to nitrogen	Dry weight of prunings tons per acre
Nitrogen	Phos: acid	Potash		Organic matter.	Nitrogen		
0	0	0	...	2·80	0·094	29·8	1·06
40	20	20	one dose March	2·82	0·096	29·5	1·45
80	40	40	one dose March	2·96	0·099	29·9	1·95
120	60	60	one dose March	3·08	0·104	29·6	2·34
40	20	20	two doses March and June	3·05	0·097	31·4	1·59
80	40	40	two doses March and June	3·22	0·103	31·3	2·05
120	60	60	two doses March and June	3·12	0·105	29·7	2·37
Significant difference		...	...	0·29	0·007	...	...

Great interest attaches to these results, which show that a significant increase in soil nitrogen and organic matter results from the application of purely inorganic manures to tea. Previously, similar results have been obtained, but differences were not significant. The greater effect of dividing the application of nitrogen, as compared with putting it all on at once is unexpected and no explanation can be offered. The increase in soil organic matter and nitrogen, due to increasing quantities of manure, is ascribed to the increased weights of prunings; but there is too little difference in pruning weights between single and divided application of manures to account for the increase in soil organic matter and nitrogen resulting from the divided application.

(2). *Preparation and analysis of compost.*

At Borbhetta a trial has been started of the relative efficiencies of composts and inorganic manures. Two methods of

preparation of compost were tried. In both cases rice straw was the source of vegetable material, but in one preparation an inorganic "starter" (the well-known proprietary substance "Adco") was used, and in the other, the Indore process was followed, using cattle manure, urine and urine earth as the source of readily available nitrogen.

The analyses of all materials were made before preparation of the stacks, and after completion of the composting the prepared composts were analysed. The table below gives comparative analyses for the two methods of preparation.

	Weight in lbs.	
	Original content of stacks.	Content after 3 months.
(*a*). *Adco method.*		
Total weight	4476	6960
„ water	2298	5120
„ dry matter	2178	1840
Total organic matter	1378	668
„ ash (including soil) ...	800	1172
„ nitrogen	34·3	19·5
Percentage nitrogen on organic matter	2·5%	2·9%
(*b*). *Indore method.*		
Total weight	9322	8308
„ water	5804	5425
„ dry matter	3518	2883
Total organic matter	1323	799
„ ash	2195	2083
„ nitrogen	30·1	24·5
Percentage nitrogen on organic matter	2·3%	3·0%

Very heavy rain fell for 4 days immediately after the making of the stacks, which were not covered, and in the case of the composts prepared with the soluble inorganic starter Adco, much of this was lost by washing out, since the straw was as yet not sufficiently spongy to hold it. A considerable increase in "ash" has resulted after composting with Adco. This is mostly ascribed to soil scraped up when lifting the stack, but is partly soil introduced by white ants, which attacked the Adco heaps, but did not attack the heaps made by the Indore method.

In both processes, the finished material was well rotted except for very thick pieces of straw. Rotting was somewhat better in the heaps made by the Indore method.

The loss of nitrogen is considerably less in the heaps made by the Indore process, probably because at the time when the rain fell most of the nitrogen was in the insoluble form, and also, because there was plenty of absorbent material (in the cattle manure) to prevent leaching out of soluble nitrogen. Thus the Indore method, under the conditions in which the compost preparations were made, has proved the better method. Had the stacks been covered, or had there not been heavy rain so soon after the laying down of the stacks, it is thought that the two methods would have given more similar results.

These composts, together with raw materials used in making composts, and soluble chemicals were applied to various plots of tea at Borbhetta in September so that it is too early to pronounce any opinion on the efficiencies of composts as compared with soluble manures and with the uncomposted "raw materials". A study of the nitrate content of the soils of the different plots indicates however that the only manures providing, as yet, any appreciable supply of available nitrogen to the bush are the soluble manures, such as nicifos and sulphate of ammonia. Results from these plots will be watched with interest in 1937, by which time the slower acting bulk organic manures should have had time to act.

E. Influence of various factors on the moisture in plucked leaf.

1. *Effect of leaving different length of initial growth, with subsequent plucking to janam and leaving a big leaf once only.*

The effect of leaving longer growth above the pruning level is to increase the moisture content of the plucked leaf during the earlier part of the season. Up to the end of July, leaf from bushes plucked to 8″, whether subsequently plucked to the *janam* or whether a leaf was left, contained significantly more moisture than leaf plucked over 4″ initial growth. The difference in moisture varied between 0.3 and 1%. There are indications, though results are not quite significant, that up to the end of October, plucked shoots from plots on which a leaf is left once only, contain slightly more moisture than that from plots plucked to the *janam*.

2. *Effect of coarse and fine plucking.*

The coarser the plucking, the more the moisture in the plucked leaf throughout the season. Differences are quite small, but between coarsest and finest plucking, are significant. The average moisture in fine-plucked leaf was 75.9%, for moderately coarse leaf 76.1% and for very coarse leaf 76.4%.

3. *Effect of manuring.*

(*a*). Varying quantities of complete inorganic fertiliser.

Moisture in the leaf increases with increasing quantity of complete inorganic fertiliser. The increase is slight, being less than 1% in leaf from plots manured with 120 lbs. nitrogen, 60 lbs. potash and 60 lbs. phosphoric acid, compared with leaf from unmanured plots.

(*b*). Varying quantities of potash and phosphoric acid with constant quantity of nitrogen.

Phosphoric acid manuring exercises no significant effect on the moisture of the plucked leaf. Potash increases the moisture

content slightly but significantly, the application of potash at the rate of 30 lbs. per acre increasing the moisture in the plucked leaf 0.3%.

F. Meteorological.

From the end of September 1935 to the beginning of April 1936 rainfall was very short, a total of only 4 inches being measured, compared with the normal rainfall for the period of 12 inches. Until good rain fell in April the soil was very dry and the effect of these droughty conditions was reflected in abnormally low second flush yields. A record low soil moisture content of 7.2% was obtained during the second week of March and the average weekly soil moisture for the month never reached 10%. Rainfall in April was about normal and was well distributed over 14 days in the month. A severe hailstorm occurred on the 6th of April. May rainfall was 3 inches in excess of normal and precipitation occurred on 19 days. Maximum and minimum temperatures were below normal during the first 10 and last 7 days, the periods when the rainfall occurred, but during the intervening dry spell temperatures were high. Crops for May were not much behind the normal, but those for June were the lowest on record, being only about half those for June 1935. The second flush, usually at its highest in the second week of the month did not come through till the end of the month. July crops were normal, but August crops were poor, though rainfall and temperatures did not vary markedly from normal. Yields for September and October were rather above normal, but the total over the year was 10% behind that of 1935. Good rain fell in October and November, and a few small showers in December were useful for nurseries and newly planted tea. The soil moisture was between 13.5 and 15.5% during December. Normally it drops to the region of 10% before the end of the year.